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**Understanding student information behavior in relation to
electronic information services:
lessons from longitudinal monitoring and evaluation Part I**

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Understanding student information behavior in relation to electronic information sources: lessons from longitudinal monitoring and evaluation.¹

Abstract

This two part article establishes a model of the mediating factors that influence student information behavior concerning electronic or digital information sources that support their learning. The first part reviews the literature that underpinned the development of the research methodology for the JISC User Behavior Monitoring and Evaluation Framework, as well as the literature that has subsequently helped to develop the model over the five years the Framework operated in the UK, in five cycles of research that were adjusted to meet the emerging needs of the JISC (Joint Information Systems Committee) at the time. The literature review attempts to synthesize the two main perspectives in the research studies: 1) small scale studies of student information behavior; and 2) the studies that focus on the quantitative usage of particular electronic information services in universities, often including implications for training and support. As the review indicates, there are gaps in the evidence concerning the browsing and selection strategies of undergraduate students, and the interaction of some of the mediating influences on information behavior. The Framework developed a multi-method, qualitative and quantitative, methodology for the continued monitoring of user behavior. The paper discusses the methods used and the project management challenges involved. Concludes that intended impacts need to be specified carefully at the outset, and that a longitudinal study needs committed funding at the outset. A research project on information behavior, intended to inform current policymaking on infrastructure provision is inherently difficult as behavior changes lag behind provision.

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Keywords: User behavior; Information behavior; Digital information resources; Electronic information services; Information use; User surveys.

1. Introduction

In the knowledge economy, universities and colleges play a pivotal role in knowledge creation, innovation and dissemination, and in learning. Globalization in higher education means that universities are opening up campuses abroad, or offering distance learning courses to students in other regions or countries, and such ventures are invariably dependent on the Internet to provide both resources and administrative support for learning. Nations differ in their policies towards the 'massification' of higher education, getting more students prepared for the knowledge economy. Wooldridge (2005) contrasts the approaches taken by the USA and Europe, noting how limited funding (and solely state funding) in some European countries has contributed to a decline in the standing of European universities in the league tables. Resources, and particularly the electronic resources and services, matter, but our understanding of their impact is only now emerging. In a higher and further education environment that is characterized by several drivers for change, it is important that information professionals and policy makers are able to make well-informed decisions concerning the development, provision and funding of electronic information services (EIS). To this end, JISC, the Joint Information Systems Committee (UK), undertook a major five year project to establish the User Behavior Monitoring and Evaluation Framework. The project both established the methodology for the Framework, and collected data using the methodology. The purpose of the Framework was to investigate and profile the use of electronic information services within higher and further education in the United Kingdom. The Framework identified the factors that mediate, or act as facilitator or barrier to the use of EIS in learning, and other knowledge work in higher and further education, and monitored changes in use and the factors that influenced use over a five year period. In summary, the Framework was designed to create a mechanism to assist managers and policy makers in further and higher education to:

'understand better and address the needs of scholars, teachers, and learners in their use of EIS' (JISC, 1999)

This article reflects on the successes and challenges of the Framework in achieving these outcomes. Part II discusses how an information behavior model was developed. As a longitudinal study, the Framework research is novel as it is, firstly, a national study including data collected from many universities and colleges across the UK. The study was positioned at a national policy level. Other studies are usually directed at informing the strategic planning for one library or a group of library services, or a resource provider. The wider perspective allowed the Framework to delve more deeply into the relationship between student information behavior and teaching and learning than is the case with some of the other studies, and take the important step of bridging the boundaries. There are lessons to be learnt from a critical analysis of the methodology established for the project. Unusually, the project included face to face interviews with a large number of students, but getting the right balance between the qualitative and quantitative elements was difficult. The paper discusses implications for the processing of longitudinal monitoring, forecasting trends and envisioning the future.

The literature review of information behavior and related themes such as information use and information literacy explains how this project relates to other studies that share some of the aims of the Framework. The next section describes the methodology of the project. This section has two purposes. First, the research design is described, with details of the methods used, the rationale, and the methodological issues. Second, the project management methodology is discussed, noting the particular factors that affected the success of the project as a longitudinal study. The discussion section covers the evaluation of the methodology, and its consequences for longitudinal data collection on information behavior. Finally, conclusions and recommendations summarize key lessons for future information behavior research and practice.

2. Literature Review

The literature review conducted at the beginning of the project identified a substantial gap in the evidence surrounding student user behavior concerning electronic information services, confirming indications from a contemporaneous review of digital library research (Chowdhury & Chowdhury, 1999). Such research projects as had been conducted were either general studies of user behavior, without a specific focus on EIS, or studied just one or two aspects of user behavior in small pilot projects, often at one institution. However, since the start of the project there has been a considerable quantity of activity alongside the work on the Framework project in both the USA and the UK, and the evidence from this research has helped inform the development of an institutional *Information Behavior Model*, described in Part II.

The literature on information behavior of students is diffuse and difficult to draw into a coherent knowledge base. Researchers have started from different standpoints, and have studied different aspects of information behavior with different groups of students. With one or two notable exceptions, there is limited use of models to help to structure the links between studies. There are two main standpoints: research into individual information behavior, and research on the patterns of usage of resources. Within the first standpoint are studies that examine the information behavior of students in specific university or colleges and disciplines. Although studies of students make up 19 per cent of the literature on information seeking (Case, 2006) many of the studies concern postgraduate or doctoral students. Studies of university students, usually qualitative and small scale, often build on different models of information behavior, and investigate student search behavior and other factors such as the role of academic staff, and the impact of discipline on information behavior. Although the focus recently has been on use of the Internet and electronic information, this research is not limited to use of particular resources. The second standpoint

is that of library management, seeking evidence to support management actions, particularly on access to information in electronic formats. These centre on the way in which users exploit specific EIS such as e-journals, and the effectiveness of library training and support policies and programs often aimed at particular resources.

2.1 Student information behavior research

This type of research is exploratory and interpretive, typically uses qualitative methodologies such as interviews and focus groups, and many of the findings are based on small groups of respondents (frequently less than 30 in number). While this work provides in-depth analysis and answers to 'why?' and 'how' questions, in many cases further research is still required in order to establish the generalizability of the themes that emerge. The research studies can be divided into three main groups: 1) studies of information seeking, sometimes influenced by a particular model of information seeking; 2) studies that examine disciplinary differences in information seeking and use, and 3) studies that look at information behavior in a wider context that often includes learning and teaching. The main themes are identified in the following sections

2.1.1 Information seeking and searching

Kuhlthau's model of information seeking, based on research with high school students, is an important point of departure for later work (Kuhlthau, 1991). The model, with the six stages of task initiation, topic selection, pre-focus exploration, focus formulation, information collection, search closure (and the seventh stage of starting writing) has been used in several studies of the information behavior of older students at college or university (e.g. Cole, 1997, Kennedy, Cole & Carter, 1999). Cole (1997) then devised a five stage model to account fully for the stages of opening, cognitive activity, seeking corroborative evidence, closing and modification of the knowledge structures. Kuhlthau's perspective on information seeking is information seeking *for* learning, but other studies (e.g. Limberg, 1999) have viewed information seeking and learning as intertwined.

Several small scale interview and focus group based studies examined how students perceive their information behavior and search strategies (Becker, 2003, Drabenstott, 2003, Valentine, 1993, Wildemuth, 2004). If information seeking and learning are intertwined, then some of these studies produce puzzling findings, with little evidence of learning about information seeking. Undergraduate students appear to opt for the easiest and most convenient method of information seeking (Valentine (1993), and they rely on simple search strategies, often using search engine searches (Becker, 2003, Dalglish & Hall, 2000, Drabenstott, 2003). However, other studies indicate that search tactics change as the domain knowledge develops (Sihvonen & Vakkari, 2004; Wildemuth, 2004; Zhang, Anghelescu & Yuan, 2005). For example, willingness to use a thesaurus, and ability to benefit from a thesaurus, to expand and vary the search terms used effectively is governed by the degree of domain knowledge. Limberg's approach could be seen as the first layer of context to be considered – information seeking and learning, but this seems hard to separate from other layers of context such as learning in different disciplines, learning for future professional work, learning within an environment of everyday information seeking for leisure and domestic purposes. A study of eight doctoral students (Chang & Lee, 2001) identified five information behaviors (seeking, reducing uncertainty, learning, value-adding (to corroborate) and disseminating). Chang and Lee concluded that there were multiple relationships between context and information behavior, but that context could be stratified. Students' information seeking should therefore relate not just to learning about the knowledge of a discipline but how that knowledge is structured and communicated, the characteristic patterns of scholarly communication. For example, Liu (2004), in a questionnaire survey of undergraduate and postgraduate students (n=128), found that students' views of credibility of information on the Web were affected mostly by markers of academic respectability in scholarly communication such as previous publication in a printed journal, inclusion of references and posting in a well respected website.

Another layer of context is the possible influence of everyday information seeking behavior, and acquired information seeking habits. These may help as when using social and work contacts are used to save time searching when obtaining assignment material (Given, 2002) or hinder if everyday information seeking has established expectations of immediate gratification. Expectations that information should be easy, and quick to find may result in decisions by distance learning students to select and use primary information resources that are fast and easy to retrieve, and easy and reliable to use (Liu & Yang, 2004). Other small scale studies of undergraduates also note that time saving is seen as the main benefit attributed to electronic resources, although the Internet does not always deliver on this (Dalglish & Hall, 2000; Lindsay & McLaren, 2000).

2.1.2 Use of information literacy models

Information literacy models are a recent addition to analysis of information behavior. Eskola (2005) used Bruce's relational model, the seven faces of information literacy, to compare information seeking of two groups of medical students, and concluded that those pursuing a problem-based curriculum had better information literacy than those pursuing a traditional curriculum. Catts (2005) has validated an information skills inventory based on Bruce's relational model. Information literacy initiatives tend to be preoccupied with the development of generic information skills, although the individual differences such as the motivation to learn or personality (Heinstrom, 2003), the type of learning task (Kerins, Madden & Fulton, 2004), teaching and learning styles (Eskola, 2005) and the ways of thinking and practice in different disciplines (Entwistle, 2003) are seen to be confounding factors in affecting information behavior. There is, however, a difference between 1) having the ability to do something (skills associated with information literacy), 2) actually feeling the need or motivation for information seeking, and 3) self-efficacy, or personal mastery (Bandura, 1977). Self-efficacy beliefs among information management students concerning information literacy and computers were correlated, but did not change much over the final years of their degree studies (Kurbanoglu, 2003). Four perspectives (psychological, social/structural,

cultural and phenomenological) may govern human information behavior such as browsing (Rice, McCreddie & Chang, 2001, p.198), and may illuminate individual factors at a particular time but these perspectives may not be sufficient to understand how changes in behavior result, and evolve. It is important to remember that evolution is about adaptation to circumstances –the fittest for that particular set of circumstances survive. It is possible to interpret some of the studies of students' information seeking in terms of 'what works, sticks' and Eskola (2005), for example, notes that the most developed information behavior was associated with work on a major project (thesis). Prior to that point, motivation was low, although the problem-based learning group was more likely to have more sophisticated searching skills.

2.1.3 The Impact of Discipline

Using the Biglan model of disciplinary differences (dimensions of hard, soft, pure, applied, non-life and life), Whitmire (2002) found some significant differences between disciplines in a large questionnaire-based study of undergraduates (n=5175), although the study also noted that the amount of information seeking was generally low. Similarly, Liu & Yang (2004) found in a questionnaire survey of distance learning students that selection of information resources was significantly related to their subject discipline. Talja & Maula (2003) found in their study sample (n=163) which comprised mainly postgraduates or academic staff, that there were disciplinary differences in the use of e-journals and databases. They could relate the searching strategies to the domain size and the type of relevance criteria most important to the discipline. Whitmire (2003) used Kuhlthau's Information Search Process together with four models of epistemological development, and identified different patterns of behavior amongst undergraduates according to the level of epistemological belief, lending further support to the intertwining of learning, discipline, and approaches to knowing what one knows.

In vocational disciplines, models of professionals' information seeking or everyday information seeking may be appropriate in understanding how discipline and routine practice merge. For example, Kerins, Madden & Fulton (2004) use Leckie's model in which work roles determine tasks which define the nature of the information needs, whereas Given (2002) uses Savolainen's framework (Savolainen, 1999) for everyday information seeking.

2.1.4 Learning and teaching, and other contextual factors

Models which attempt to take a wider perspective on the context of information seeking by students include the integrated human information behavior research framework (Sonnenwald & Iivonen, 1999), and in later work, the consideration of the context and situation as an information horizon in which information seeking takes place (Sonnenwald, Wildemuth & Harmon, 2001; Savolainen & Kari, 2004). In the former study information horizon maps are used together with techniques derived from social network analysis to study students' information seeking behavior. These go some way towards meeting one of the criticisms of much Web information seeking research (Martzoukou, 2005), that social and cultural aspects are neglected.

Few studies specifically examine how academic staff affect the information behavior, or even the learning behavior of students. The ETL (Experiences of Teaching and Learning) project (Entwistle, 2003) examined the pedagogical differences between disciplines. Some disciplines are more teacher-focused, whereas others (biology, history) emphasize conceptual understanding and the ways of thinking of professionals in the subject area. If the emphasis is on ensuring students understand, the information skills are not seen separately (Kerins, Madden & Fulton, 2004).

Problem-based learning, or resource-based learning, should theoretically produce students with good information literacy. Eskola (1999) (2005) found that medical students following a problem-based curriculum had better information literacy than medical students following a

traditional curriculum. Martin (2003) found that students on a graduate entry program to medicine, using elements of problem based learning, used significantly more e-journals and databases than the traditional medical school undergraduates. Kim (2001) investigated how cognitive style, online database search experience, and type of task, influenced searching by undergraduates (n=48) for Web resources. For novice online searchers, field dependent (global) searchers took significantly longer than novice field independent (analytical) searchers. Generally, the field dependent individuals needed a longer time, and searched more links, but the effect of database search experience was to reduce the amount of time required. Allen & Kim (2000) found that there was no significant interaction between cognitive style, abilities and context variables such as task. Cognitive differences acted independently of task. Allen & Kim suggest that motivation to learn may be a confounding factor. Certainly Heinström (2005), who measured personality traits and approaches to studying among 300 postgraduate students, identified three types of behavior: fast surfing, broad scanning and deep diving (a deep and strategic approach).

The evidence from the studies indicates that different disciplinary approaches to learning and teaching may influence students' information behavior (Eskola, 2005), but the developmental changes in intrinsic behavior seem to require strong extrinsic motivation to learn in the form of a task such as a major project, or research. More sophisticated information behavior might only be observed among postgraduate research students. For many undergraduates, the picture is complex, and what is observed in some of the studies may be a process of 'unlearning' previous habits as much as learning the ways of thinking in a new discipline. If we can understand the context better in terms of fields (the set of circumstances that determine the individual's knowledge, awareness, and likely attitudes) and pathways (that explain the flow of information behavior) (Johnson et al., 2006) then the learning and unlearning, the 'messiness' of information behavior might be expected.

2.1.5. Information behavior models and research philosophies

It is important to recognize that the models used in several of the studies of information behavior vary in their underpinning research philosophy. The studies based on Kuhlthau are essentially constructivist, and the process which involves reflection, action, and interpretation, is central. The information seeker is an agent, making meaning as they proceed, with reality known through cognitive structures. Other approaches place the information seeker in the midst of many contextual factors which may affect information seeking, and the global information behavior model of Wilson & Walsh (1996) is perhaps the most well-known example of this. This has been described as the objectified approach to context (Talja, Keso & Pietiläinen, 1999). Realism, in contrast to constructivism, emphasizes that realities underlying knowledge do exist, and attempts to integrate three methodologies: the possibility of a causal explanation; the communicative construction of social reality; and the critical dimension (Delanty, 2005, p.145). Wikgren (2005) suggests that critical realism could be applied to models of information behavior. It is not enough to observe and interpret, perhaps, but to understand some causes and relations, and then to make changes. But as a distinguished sociologist remarked (Runciman, 1998, p.208) *'What's wrong with do-gooder sociology isn't the motives of its practitioners but their assumptions'*. That, perhaps, is the warning to be placed on attempts to understand information behavior in terms of information literacy – who is bothered about information literacy, the information professional (with their toolbox of cures) or the information user/agent? The 'information seeker in context' approach may avoid some of the assumptions implicit in the information literacy approaches, that assume the naïve information seeker requires tuition, but the 'information seeking problem' may be a problem that is real only to the information professionals. Spink and Cole (2006) contrast three interdisciplinary approaches to understanding human information behavior: 1) everyday information seeking and sense-making; 2) information foraging; and 3) problem solving approaches, and point out that an approach based more on the theory of information use might help to integrate some of the different perspectives. Interpreting student behavior in terms of what works, and why (the costs and benefits of information foraging) and in which circumstances (the sense making) may help towards an understanding of what may trigger

an adaptive change in behavior – or is this simply another label for learning, as might be expressed in the higher order cognitive goals of synthesis and evaluation (Bloom, 1956) ?

2.2 Research on the use of the electronic library

The other main category of research embraces those studies that have focused specifically on student and faculty use of electronic resources. The central purpose of most of this research is to generate information to inform local management or policy decisions. However, although the starting points of this research and that discussed in the previous section differ, there is some confirmation of the findings relating to student information behavior between the two different types of studies. This section therefore discusses research under two headings: Use of EIS (to complement the information seeking and searching, and disciplinary differences); and Library training and support (which links with the studies based on information literacy models). As there are a large number of studies, the reviews are identified first and reference made to individual studies included in the review only where particularly pertinent to the Framework research).

2.2.1 Use of EIS

Tenopir (2003) reviewed research studies of the use of electronic library resources, synthesizing the findings of several of the large scale studies (Tier 1 studies), that examined a variety of participants, usually in higher education, and sometimes with a variety of methods. The Tier 1 studies include the SuperJournal studies that profiled use of electronic journals by faculty and students in various disciplines, in a controlled environment. Disciplinary differences were evident, but undergraduates were most likely to be classed as non-repeat users (Eason, Richardson & Yu, 2000), using the journal set only once. Similarly, the Digital Library Federation/Council on Library and Information Resources large scale survey (Friedlander, 2002; Healy, Dagar & Wilkie, 2002) identified disciplinary differences in the usage on e-journals, and also some gender differences in the strategies to access e-journals. The Stanford E-journal user study (Institute for the Future, 2002) focused more on

the ways e-journals were changing the nature of scholarly communication and information management by scholars, and included an ethnographic study among users of the biomedical literature. The EPIC study (EPIC, 2004) an online survey of students (undergraduate and graduate) in Political Science, International Affairs and Earth/Environmental Sciences at four-year colleges and universities across the United States found that students are heavily dependent on electronic resources for their coursework. Students find out about specialist resources through the library website, and their academic staff. On the other hand, students are more likely to use a search engine than to go to a specialist resource provided via the library, echoing findings of the earlier OCLC/Harris study (OCLC, 2002), and the Pew Internet and American Life study that tracked the increasing awareness and expertise in the use of Internet by middle, high school and college students (Jones, 2002; Levin & Arafah, 2002). Many of these studies have large datasets (EPIC included 1233 students, the Pew Internet and American Life study included 2054 responses) but the amount of ethnographic detail is limited.

The OHIOLink studies take a different approach to the survey approaches, examining log files to study usage levels and patterns (Dierdrichs, 2001). Tenopir (2003) notes that the pattern of usage in this consortium may be different from other consortia, whilst Davis (2002) goes further and challenges the generalizations about user behavior made on the basis of the OHIOLink analysis.

A valuable aspect of some of the longitudinal studies of usage is tracking the changes in behavior. Tenopir and King (e.g. King & Tenopir, 2001) have surveyed the reading habits of scientists, engineers and social scientists since 1977 and have been able to demonstrate that some faculty are reading more, but spending less time per reading than in the past. Changing attitudes may also be tracked through quality surveys such as LIBQUAL+™. Attitudes towards access and minimal levels of service for electronic collections are examined in the questions and changing priorities can be assessed.

2.2.2 Library training and support

Providing digital reference services or training programs is assumed to be a good thing and part of the function of library services. Quality guidelines (McClure et al. 2002; Poll, 2001) accept these assumptions with measures such as 'user support: training sessions offered and taken up' or 'staff time assisting users with technology/total staff time for digital reference'. The format of training and support has received less attention. Joint (2003) evaluated whether provision of information literacy support in the form of a computer aided learning package within a Virtual Learning Environment was as effective as a hybrid user education model (courseware plus librarian support) or the traditional user education program. Results indicated that higher order skills may require more tutor-led support. Similar findings emerged from a comparison of online interactive tutorial for library skills training, compared with normal face-to-face delivery by library staff, in Deakin University (Churkovich & Oughtred, 2002). Students doing the online tutorial gained lower post-test mean scores and were less confident. Colvin & Keene (2004) assessed whether learning can be enhanced through promoting the use of electronic journals, and concluded that induction and training encouraged students to use more advanced searching techniques.. The health sector has been particularly active in the development of information skills training for students, partly in response to the need to equip students with the skills for evidence-based practice. A systematic review (Brettle, 2003) of information skills training in the health sector noted that, out of 24 studies included in the review, only five carried out pre- and post-skills testing, and only four studies linked assessment to student coursework as part of their curriculum. The review noted the generally low quality of the evaluation designs, with little use of validated questionnaires, and little consensus on what to measure and how.

2.2.3 Researching use of digital information resources

Unsurprisingly much of the research concerning use of electronic information resources has had to focus on the metrics of the research, what can be measured and what it might mean. We can measure which resources are accessed, possibly by whom, and the length of time spent on particular resources, and we can identify types of searching profile (Nicholas et al. 2004). For student use of electronic information resources provided by the libraries, there is little firm evidence on the effectiveness of promotional strategies, or the training programs provided. The most likely confounding factor between provision of resources and use by students is the influence of academic staff (and that may include their skills, attitudes, and approach to learning and teaching).

2.3 Conclusion for Literature Review

Research from the two standpoints should answer the following two distinct, though related questions: 1) How do students search for information? and 2) How do students use digital information resources? The research is hard to synthesize, as there are still important gaps in both approaches. As Hargittai (2006) points out, data about users' typical IT access and experience may be missing from studies of the use of digital information resources. The influences of peer group, and tutors may not be fully recognized by either students or tutors, and the links between information seeking and learning are indistinct, as there has been little research on information use after the information has been sought and retrieved, apart from studies that have looked at student use of information for projects. Student information seeking for projects may follow a stage model, the problem solving approach, but that may not necessarily apply to information seeking done for other parts of their learning and coursework. The Information seeking research, from the perspective of the researcher is easier and more productive to do with groups that actively seek information for their work or study such as academics or postgraduate researchers. Undergraduate students may apply everyday information seeking behavior to their studies, but the theoretical frameworks developed for browsing (e.g. Rice, McCreddie & Chang, 2001) do not seem to cope adequately with a group of users who may be listening to music, searching the Web, and

chatting to friends (physically and virtually), almost simultaneously. The time scales between different types of information seeking are drastically curtailed. There are gaps in understanding how the contextual factors, such as student searching experience, access to IT, tutor expectations may themselves interact. The Framework research and the model derived from that research attempts to address some of the gaps.

3. Methodology

3.1 Research philosophy

The philosophy underlying this research is that of critical realism. In seeking to understand the contextual factors that influence information behavior the research not only seeks to observe and interpret, but also seeks to understand cause and relations, in pursuit of changes in management action and policies (Delanty, 2005, p.147; Wikgren, 2005). However, the researchers also recognize that they need to be alert to their own assumptions, and their funders' motives in intervention and change. Whilst managers and policy makers may welcome change, information users or agents may choose not to change their information behavior despite initiatives from information professionals or other educators.

3.2 Structure of the Framework

The structure of the Framework project lies at the heart of its methodology, outcomes, and challenges and successes. The structure of the project was defined by JISC, in its call for tenders for the project, and subcontracted to research teams at two separate universities, and a coordinator, known as the JISC Scientific Advisor, based at a university sector college.

The project was executed through three main strands:

- A A general survey of end users of all electronic information services*
- C. A general survey of EIS provision*
- D. A qualitative longitudinal monitoring of EIS use.*

Strands A and C were executed by the JUSTEIS Project Team, based at the University of Aberystwyth. Strand D was executed by the JUBILEE Project Team at the University of Northumbria. This article focuses on Strands A and D, as Strand C examined EIS provision through analysis of EIS websites and little research was conducted for Strand B.. In addition, it is important to note that the Framework collected data from academic staff, postgraduate and undergraduate students and library and information service staff. However, the focus in this article is on student information behavior and insights that were gathered about the factors that affected that behavior. Initially the Framework focused on universities and university sector colleges, but was extended in later cycles to include further education colleges.

The Framework operated, and was funded as five annual cycles of the academic year (September to June), during each of which the Framework methodology evolved, and further data was collected. Further details of the activities in each cycle are summarized in Table 1. Reports were produced at the end of each cycle and at the end of Cycle 3 a cumulative report was produced (JISC, 2001). Further details of other project reports may be found on the individual project sites (JUBILEE, 2004; JUSTEIS, 2004)

Table 1: The Evolution of Activities over the Five Annual Cycles of the Project

Cycle Number	Date	Activities
Cycle 1	1999/2000	The research design and data collection methodologies for the Framework were established, with particular reference to questionnaire and interview design, and access methods. Preliminary findings were reported
Cycle 2	2000/2001	The methodology was further validated through use with different groups. In addition, the methodology was refined on the basis of experience with Cycle 1. Further population of

		data sets was undertaken. A pilot study was conducted in further education.
Cycle 3	2001/2002	Deliverables were crystallized, with yet further population of datasets for higher education. A prototype of the Action Plan for HE managers was developed. A full scale project was conducted in further education that included both survey and action research components.
Cycle 4	2002/2003	Further monitoring of information behavior and population of datasets was undertaken. Data mining of data from earlier cycles was undertaken to investigate trends in information behavior, and barriers to e-learning. Further data was collected in FE both through surveys, and action research. Some dissemination was undertaken. The web based Action Plan toolkit was tested, developed and refined.
Cycle 5	2003/2004	The Framework methodology was consolidated and further population of datasets undertaken, and a data archive for users of the Framework was developed. Longitudinal analysis of the data over the five year period was conducted. The Framework was extended to new communities in Adult and Community Learning, Modern Apprenticeships, and HE in FE. Active dialogue with specific audiences, and policy groups, to further extend Framework data sets, to promote engagement with Framework methodologies and to disseminate outcomes was promoted.

3.2 Framework Research Design

The research design underpinning the Framework is complex, and involves a number of different sampling schemes at individual and organizational level, the design and use of a wide range of different data collection methods, including questionnaires, interviews, themed snapshots, use of the critical incident technique, action research, and prototype development. It supports the collection of both quantitative and qualitative data. Table 2 summarizes the extent of data collection over the five cycles for Strands A and D, in terms of the number of respondents. In total, Strand A engaged with 137 further and higher education institutions (well over half the higher education institutions in the UK). Strand D's work included repeat visits to sites visited in earlier cycles to assess the extent of changes made. Strand A collected data from 3762 respondents, including academic staff, library staff and students, and Strand D collected data from 4254 respondents, including, again staff and students. Further details of the methodology for each strand follow.

Table 2 : Data Collection and datasets on Information behavior from the five cycles of the Framework

		Higher Education	Further Education	Action Research	Total
<i>Staff Questionnaires</i>	JUBILEE	395	105	5	505
	JUSTEIS	78	22	0	100
	Total	473	127	5	605
<i>Student Questionnaires</i>	JUBILEE	1318	1681	69	3068
	JUSTEIS	1524	524	47	2095
	Total	2842	2205	116	5163

<i>Staff</i> ² <i>interviews/Focus</i> <i>Groups</i>	JUBILEE	261	223	32	516
	JUSTEIS	159	58	27	244
	Total	420	281	59	760
<i>Student e-mail</i> <i>interviews/focus</i> <i>groups</i>	JUBILEE	34	42	89	165
	JUSTEIS			100	100
Individual student interviews	JUSTEIS	710	513		1223
	Total	744	555	189	1488

3.2.1 Strand A

The objective of strand A was to:

Undertake a periodic survey of EIS uptake and use, investigating the quantity and quality of take up with a view to bridging the gap between the perceptions and reality of user behavior.

Strand A used a multi-stage stratified sampling process. This was designed to ensure that the sample included small, medium and large higher education institutions, as well as different types of institution. Departments were then selected within institutions, distributed amongst five disciplinary clusters. The original intention was to select students within departments randomly. However access problems led to very low initial response rates. The

² Includes both academic and library and information services staff

methodology was modified during Cycle 1, and the modified approach was used in subsequent cycles. The modified approach retained the principles of the multi-stage stratified sampling but used substitution to cover departments that were unable to participate, and convenience samples at the student, and staff levels. Access methods at different institutions varied. The number of respondents is summarized in Table 2.

Data collection methods comprised:

- Critical incident interview/questionnaire, with use of a critical success factors technique and vignette, to assess use of EIS, attitudes towards EIS, awareness of EIS and searching strategies among 1) students and 2) academic staff.
- Interviews with senior library managers, to assess their perspectives on purchasing of EIS, and the support required for EIS
- Small scale action research projects in further education colleges (similar to American community colleges)

The critical incident interview and questionnaires shared common themes. The questionnaire asked respondents to think back to an occasion during the last week when they needed to find information. Fourteen questions then probed the event in terms of the purpose of the information search, how the search was conducted (including assistance sought, urgency and time taken), the resources used for the search, the guidance that led to the electronic resources used for the search, search outcomes in terms of satisfaction, problems and success, and information skills training. The interview schedule included similar questions, but face to face interviews with students helped to explain the actual search strategies used, and attitudes towards use of electronic information services, as well as confirming awareness (or not) of particular services. Reflections on the critical incident technique used (Urquhart et al., 2003) suggest that critical incident interviews with students of their use of EIS, needs time, and skill on the part of the interviewer, to draw out just what the student did, and their rationale for the approach used.

Data from both face to face and telephone interviews were transcribed and entered into a qualitative software package (QSR N4, later N6) for coding and further analysis. Quantitative data was extracted from the interview transcripts manually and some data entered into SPSS for collation with the data from the questionnaires.

3.2.2 Strand D

The objectives of Strand D were to:

- Understand user interaction with EIS in context
- Measure the changes longitudinally using criteria that reflected the user perspective
- Develop success criteria for use of EIS, and to use these as a basis for the Action Plan for HE Managers toolkit.

Six fieldwork higher education institutions were recruited for each cycle, taking into account: the type of institution, size, whether the institution was multi-site or single campus, and geographical spread across the UK.

One science, one social science, and one arts discipline were included in each cycle, with some alterations made in later cycles to accommodate the further education sector sites, and the necessary revisits to examine changes in cycles 3 and 4 (Table 3).

Table 3 : Strand D fieldwork plans

Cycle	Disciplines	Revisits
1	English, Health and Business	
2	History, Sociology, and Computing	
3	Design, Law, and Geography/Environmental Studies	Health and Business
4	Politics, Biology, Film Studies/Media	Sociology and History
5	Information Technology/Computing, Business,	Business and Law

	<p>Sociology and/or Psychology in higher education;</p> <p>Biology, Business, English, Foundation Degree, Early Years, Modern Apprenticeship, Catering and Hospitality in further education colleges.</p>	
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Research methods used were:

- Questionnaire surveys (staff and student) , in paper and e-mail versions
- Interviews with academic and library staff at case study sites
- Informal feedback from students and staff;
- Small scale action research projects in further education institutions (FEIs) (similar to American community colleges)
- Re-visit case studies to monitor changes and test the Action Plan for HE Managers toolkit (Banwell & Coulson, 2004)
- Impact case studies
- Development and testing of the Action Plan for HE Managers web-enabled toolkit prototype.
- Roundtable study with JISC audiences (both research teams were involved in this)

Electronic observatories were established in Cycles 1 and 2, but despite several attempts to refine their design, these did not attract sufficient participants, staff or students, to be worthwhile.

Quantitative data was entered into SPSS. Approaches to handling the qualitative data varied. QSR N4 qualitative data analysis software was used for Cycle One, but not for later Cycles of Strand D. Reports for each case study site were collated to inform the sites

themselves, and to enable them to validate the data collected by the JUBILEE researchers. The case study report contents remain confidential to the sites.

4 Project management

4.1 Conducting a longitudinal study of information behavior: a critique

The vision of a Framework that would create a longitudinal profile of the use of electronic information services, and the development of an understanding of the enablers and barriers that affect such use has much to recommend it, especially if such a Framework could generate relevant data that impacted on policy-making and practice. However, after five years of operation funding for future cycles of the Framework project was terminated. This presents an opportunity to evaluate the successes and challenges of the Framework, both at the operational level, from the researcher perspective, and at the policy level, from the perspective of independent consultants. This section summarizes these two perspectives, to help inform any future research into information behavior and any future initiatives designed to generate longitudinal datasets of the information behavior. Such a critique also has value as a basis for understanding and interpreting outcomes of the Framework project.

4.1.1 From the research team perspective

The research teams note the successful generation of a methodology for evaluation of user behavior with electronic information services, and the research has compiled a considerable longitudinal data set including both quantitative and qualitative data. Outcomes were delivered as required, and project teams have reported regularly to the funder's committees, and submitted significant reports on an annual basis. The project teams worked together, met and coordinated their activities. There has been wide dissemination of the activities and outcomes of the project both through professional, policy and academic channels in the UK and beyond.

Nevertheless, conducting a cross-sectoral survey using a mixture of qualitative and quantitative approaches, working with two project teams and three strands posed a number of dilemmas both in research design and project management. Some of the points below are developed further in Rowley (2002). In relation to research design key challenges related to:

- The management of the **integration** of work conducted under the two strands. The structure of the Framework was non-negotiable, yet somehow from the various Strands and work it was necessary to draw out a coherent and representative message. This involved managing integration at different levels:
 1. Research design and distinctiveness of the objectives of different projects
 2. Standardization of terminology and taxonomies of EIS, and types of information use, as appropriate.
 3. Communication on fieldwork sites used, questionnaires and interview schedules
 4. Evolution of analytical approaches and conceptual frameworks with both common and distinctive project based features
 5. Coherent dissemination.
- **Representativeness, sampling and access** - Achieving representativeness at institutional level proved to be practically incompatible with representativeness at the individual student level, and the samples of users for both Strands became 'lumpy'. Respondents were typically difficult to locate, access and activate. Whilst there is reason to be confident that the range of perspectives is well represented in the sample achieved, precise measurements of the significance of specific factors are more difficult to achieve.
- **Measures** - A key aspect of research design is the selection of appropriate indicators or measures of use. This involves consideration of a number of factors, amongst which are:
 1. Which categories should be used for analysis? For example, what informs the typology of the purposes for which users use EIS?
 2. Which user categories should be used to analyze and report behavior?

3. Which terms can be used to report behavior? A perennial problem is that users are extremely naïve about formal descriptions of types of EIS.

- **Interpreting data** - Quantitative data analysis generated statements like: *46.9% of undergraduate students cited assignment or lab report as a purpose for using EIS*. What does this mean? Why is this figure higher than for other use purposes? What percentage would be acceptable? Do we have any benchmarks that can be employed to indicate the link between activities or purposes and specific types of information sources? These types of questions emphasize the need to ask what?, why?, and how? questions in parallel. 'Skimming' to obtain a broad picture, must be accompanied with a considerable amount of 'dipping' as an aid to interpretation of any questionnaire based data. The down side is that this leads to complex research designs and challenges for analysis and presentation of results.

At the project management level the research teams wrestled with a number of contextual challenges:

- The definition of the project as separate strands, one with a qualitative bias (focusing on 'why?') and the other with a quantitative bias (focusing on 'what?') presented a range of difficulties because it is not possible to define a clear boundary between the data needed to answer 'what?' and the data needed to answer 'why?'
- Timing problems appeared in two ways: Annual reporting cycles allowed little time for integration and digestion of results into a coherent set of outcomes before the commencement of the next cycle of data collection, and the use of annual contracts had implications for staff turnover, leaking of staff expertise, and diversion of the project directors' focus from conceptual issues, to staff management issues.
- No mechanisms or resources for achieving a sufficient level of knowledge of, and integration with JISC policy making activities (partly as JISC was restructuring itself during the period)

- Evolving agendas over the time period of the study: not just in terms of the range of EIS available to users but also a plethora of relevant government and other sector specific initiatives, especially in the further education sector; together with the introduction of VLE's, Virtual/Managed Learning Environments such as WebCT and Blackboard, and their potential impact on the extent and nature of information use (Brophy, 2001). This meant the scope of the Framework continued to enlarge.

4.1.2 From the Independent consultant's perspective

As part of a wider review of all of JISC's monitoring and evaluation activities, independent consultants evaluated the relevance, management, value for money and dissemination associated with the Framework. Their overarching criticism of the Framework was:

'The two projects within this programme are now in their fifth years and while they have produced detailed findings, we do not consider their impact to be commensurate with their cost.'

More specifically, the following weaknesses of the project were stated:

- There is little evidence of impact, in terms of the influence on decisions made by JISC committees, despite the fact that many JISC committee members and staff consider it to be relevant to JISC's work.
- There is a lack of contact between the two project teams
- The Framework sees itself as a research oriented project rather than as a service
- Awareness of the Framework is relatively poor within the JISC and across universities, partly due to 'the poor quality of the web sites provided by JUBILEE and JUSTEIS'.

The accuracy or appropriateness of these assertions is immaterial. They are important because they contributed to the termination of the Framework, and offer insight into factors

that need to be considered if the management and policy issues to sustain the funding of a longitudinal study are to be successfully addressed.

5. Discussion

The Framework approach has successfully developed a methodology that has delivered useful insights into the use of EIS to support learning in higher and further education. The framework is ambitious and sophisticated. Its particular strength is the broad base of institutions and communities with which it has variously engaged. The Framework has reached the reluctant users of EIS as well as the enthusiasts.

The key research design issues to be considered in any further longitudinal studies of information behavior are discussed in the following sections.

5.1 Multi-method approach

Combining qualitative and quantitative methods is essential. Questionnaires provide a way of identifying trends, but qualitative data from face-to-face interviews with students revealed problems that might have been overlooked in the interpretation of the terminology, and very often the qualitative data suggested new trends in information use that could then be verified against the quantitative data. Strand A developed a 'skimming and dipping' approach to the data collection (Urquhart et al., 2003). Strand D used a variety of other approaches to assess changes in attitudes (Banwell, Coulson & Ray, 2003; Banwell & Coulson, 2004). Together, these Strands helped to build the rich picture that is necessary to the type of understanding of user behavior that is appropriate for informing future developments, as the series of briefing papers produced in 2003 illustrates (JUSTEIS, 2004).

Any longitudinal study needs to use an evolving methodology that changes to reflect both developments in user behavior and also developments in the education sector, and government agendas relating to the sector. Google was a glimmer on the horizon in Cycle

One, and the rest, as they say, is history. Government agendas to promote e-learning, introduced in the middle of the project, meant that more emphasis on the learning and teaching strategies adopted by universities and colleges was required. One response was in-depth analysis of the data set to examine reasons why virtual learning environment progress was slow (Urquhart et al., 2004)

Unfortunately, innovation takes time to disseminate and resource injection does not immediately affect academic or student user behavior. The first Cycle findings contained disappointing findings (for JISC) about the use by students of the subject gateways funded by the JISC. Evidence is not always positive, and this should be taken into account when interpreting the results from any survey of information behavior. Equally, sponsors need to realize that the evidence presented may only substantiate what they thought they knew already. Perhaps the way around this is to ensure that the policymakers set down their beliefs, e.g. about the trends in information behavior, at the beginning of one cycle of the research, and then compare them honestly with the research evidence at the end of the cycle. That research evidence on information behavior across large communities, such as student in universities, or health information users demands extensive data collection to provide a sufficiently representative and insightful evidence base for policy and action.

5.2 Project management

Key project management issues are:

- Intended impacts need to be specified at the commencement of the study, and mechanisms for ensuring, and monitoring impact, and evolving expected impacts need to be ongoing through the study. Such impacts should have specified timescales, and measures.
- If such surveys are to interact with longitudinal policy-making processes, the mechanisms of that interaction need to be more clearly articulated and operationalized

- Ambiguities regarding audiences for the findings of the study need to be eliminated.
- Longitudinal studies need a commitment to funding that is longer than annual cycles in order to achieve: stability in: vision and long term direction; staffing; agendas; operations; methodologies; resources; web sites; and, databases.
- Dissemination activities, including the design and maintenance of effective web access to reports and data sets need to be integral to the project, and not viewed as an 'add-on'.
- The contracting and control structure of the project needs careful design. The Framework would have benefited from a manager, rather than a coordinator, with the manager having full control over sub-contracting.

6 Conclusions

These conclusions and recommendations relate to this article, which is Part 1 of a two-part article. Further conclusions and recommendations on the nature of information behavior and the factors that influence information behavior are presented in the conclusions and recommendations for Part 2 of this article.

This Part 1 has reviewed the diverse literature on information behavior and sought to draw together, into an integrated knowledge base, student information behavior research and research on the use of the electronic library in academic environments. Previous studies are diverse in their focus, perspective, underpinning research philosophies and methodologies. In particular, many of the information seeking studies are small scale and sample characteristics preclude easy synthesis of data. The research on student searching behavior often focuses on the role of 'convenience', but there is a gap in understanding how students assess what will suffice for a particular learning task. Browsing is not a single task, and students may be multi-tasking as they passively or actively use digital information resources. Postgraduate researchers and academic staff need to actively forage for information, and review the information found, but within that group of information users, skills must vary

considerably, and disciplinary needs vary as well. The research on digital information resource usage does not adequately answer many of the questions about resource choice selection, or how the information is used for learning, although such research is valuable in tracking longitudinal trends in use of particular resources by academic staff and research students. The literature review revealed a pressing need for a Framework of the mediating factors that influence student information behavior that could be used to position subsequent research projects relative to one another and previous work.

The second main theme is this part of the article is the methodology for the Framework. The establishment of this Framework represented recognized the need to conduct both qualitative and quantitative research, and to collect longitudinal data that could impact on policy-making and practice. The article presents a description and a critique of the Framework methodology, both as a basis for understanding and interpreting the outcomes of the Framework projects, and also to inform future large-scale information behavior projects. Challenges for research design for such projects include:

1. Integration, both at a practical level between researchers and teams, and at the level of research philosophy and methodology. It is important to use both qualitative and quantitative methodologies, but some approaches for their integration needs to be developed.
2. Representativeness, sampling and access, especially across large and scattered communities
3. Definition of measures and indicators of information behavior and use.
4. Interpretation of data in such a way that it can be used as a basis for decisions and policy-making and actions.

In addition, it is important that research funders and sponsors recognize the challenges and consider carefully the impact of the following factors on the quality of the evidence that researchers are able to generate:

1. time cycles for contracting, funding and reporting

2. early and ongoing articulation of their expectations and notions of impact
3. relationship building between contract research teams and the policy making bodies and processes of the sponsoring agency
4. the proactive management of the evolution of longitudinal research studies to accommodate changes in the subject under study and its context.

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